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*Indian Standard*

**ELECTROMECHANICAL SWITCHES FOR USE IN  
ELECTRONIC EQUIPMENT**

**PART 6 SECTIONAL SPECIFICATION FOR SENSITIVE SWITCHES**

ICS 31.220.20

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**BUREAU OF INDIAN STANDARDS**  
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NEW DELHI 110002

## NATIONAL FOREWORD

This Indian Standard which is identical with IEC 1020-6/IEC QC 960300 (1991) 'Electromechanical switches for use in electronic equipment — Part 6 : Sectional specification for sensitive switches', issued by the International Electrotechnical Commission (IEC), was adopted by the Bureau of Indian Standards on the recommendation of Electromechanical Components and Mechanical Structures for Electronic Equipment Sectional Committee (LTD 7) and approval of the Electronics and Telecommunication Division Council.

The text of the IEC standard has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
- b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

Only the English language text in the International Standard has been retained while adopting it. This standard is intended primarily for use under IECQ system.

## CROSS REFERENCES

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence for the editions indicated :

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
IEC 1020-1/ IEC QC 960000 (1991) Electromechanical switches for use in electronic equipment — Part 1 : Generic specification	IS QC 960000 : 1994 Electro-mechanical switches for use in electronic equipment : Part 1 Generic specification	Identical
IEC 512-6 (1984) Basic testing procedures and measuring methods — Part 6 : Climatic tests and soldering tests	IS 12448 (Part 6) : 1991 Basic testing procedures and measuring methods of electromechanical components for electronic equipment : Part 6 Climatic tests and soldering tests	Technically equivalent
IEC 68-1 (1988) Environmental testing — Part 1: General and guidance	IS 9000 (Part 1) : 1988 Basic environmental testing procedures for electronic and electrical items: Part 1 General ( <i>first revision</i> )	do
IEC 68-2-6 (1982) Environmental testing — Part 2: Tests. Test Fc and guidance:Vibration (sinusoidal)	IS 9000 (Part 8) : 1981 Basic environmental testing procedures for electronic and electrical items: Part 8 Vibration (sinusoidal) test	do
IEC 68-2-13 (1983) Environmental testing — Part 2 : Tests. Test M : Low air pressure	IS 9000 (Part 13) : 1981 Basic environmental testing procedures for electronic and electrical items: Part 13 Low air pressure test	do
IEC 68-2-27 (1987) Environmental testing — Part 2 : Tests. Test Ea and guidance: Shock	IS 9000 (Part 7/Sec 1) : 1979 Basic environmental testing procedures for electronic and electrical items: Part 7 Impact test, Section 1 Shock	do

## *Indian Standard*

# ELECTROMECHANICAL SWITCHES FOR USE IN ELECTRONIC EQUIPMENT

## PART 6 SECTIONAL SPECIFICATION FOR SENSITIVE SWITCHES

### 1 General

#### 1.1 Scope

This part of IEC 1020 applies to the sub-family of sensitive switches within the family of electromechanical switches of assessed quality. Sensitive switches covered by this part of IEC 1020 have a rated voltage not exceeding 300 V and a rated current not exceeding 25 A (d.c. or r.m.s. values).

This part of IEC 1020 includes, but is not necessarily limited to, the following sub-families of sensitive switches:

- single break sensitive switches;
- double break sensitive switches;
- single break sensitive switches assemblies;
- double break sensitive switches assemblies.

The object of this part of IEC 1020 is to:

- a) prescribe preferred ratings and characteristics;
- b) select the appropriate quality assessment procedures and test methods from IEC 1020-1;
- c) prescribe the general performance requirements for sensitive switches.

#### 1.2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of IEC 1020. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of IEC 1020 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 68-1: 1988, *Environmental testing - Part 1: General and guidance.*

IEC 68-2-6: 1982, *Environmental testing - Part 2: Tests. Test Fc and guidance: Vibration (sinusoidal).*

IEC 68-2-13: 1983, *Environmental testing - Part 2: Tests. Test M: Low air pressure.*

IEC 68-2-27: 1987, *Environmental testing - Part 2: Tests - Test Ea and guidance: Shock.*

IEC 512-6: 1984, *Electromechanical components for electronic equipment; basic testing procedures and measuring methods. Part 6: Climatic tests and soldering tests.*

IEC 1020-1: 1990, *Electromechanical switches for use in electronic equipment. Part 1: Generic specification.*

### 1.3 Terminology

In addition to the terminology specified in IEC 1020-1, the following definitions shall apply to all sensitive switches.

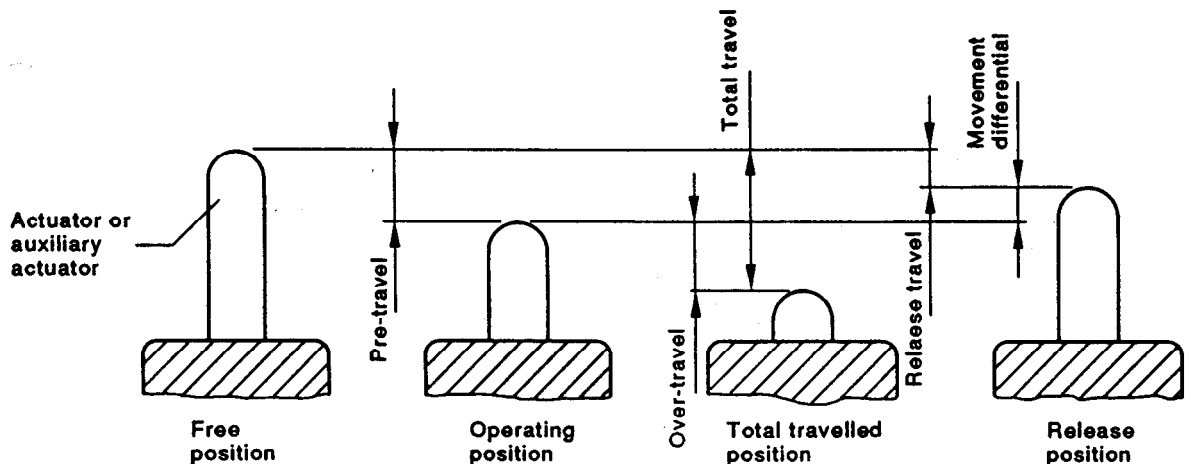
1.3.1 **angle of throw:** The number of degrees of rotation through which a rotary actuator travels in moving from one position to the next position.

1.3.2 **enclosed sensitive switch:** A sensitive switch which has all parts of the switching mechanism enclosed, but not sealed, by a housing.

1.3.3 **normally closed contacts:** A contact pair that is closed when the switch actuator is in the free position.

1.3.4 **normally open contacts:** A contact pair that is open when the switch actuator is in the free position.

1.3.5 **operating characteristics:** The force, position and travel parameters related to the movement of the switch actuator.



1.3.6 **sealed sensitive switch (or switch assembly):** An enclosed sensitive switch (assembly) which has all parts of the switching mechanism sealed in a housing.

### 1.4 Marking

The marking requirements of IEC 1020-1 apply.

### 1.5 *Detail specification*

Detail specifications shall be derived from the relevant blank detail specification.

Detail specifications shall not specify test severities or performance requirements which are less than those specified in this part of IEC 1020.

When more severe test severities or performance requirements are included, they shall be clearly described in the detail specification and shall be indicated in the test schedules by a special notation such as an asterisk.

If the technical requirements of the generic and/or sectional specification relative to inspection are not entirely suitable (either for technical reasons or because of special applications) to the sensitive switch described in the detail specification, the detail specification shall set out clearly the modifications which are to be made to these requirements.

The detail specification shall state directly, or by reference to other standards, all information necessary to completely describe all interchangeability parameters for that type of sensitive switch, including any styles and variants, and to ensure conformance thereof with all requirements for quality assurance.

The following information shall be given in each detail specification and the values prescribed shall preferably be selected from those given in the applicable clause of this part of IEC 1020.

#### 1.5.1 *Preparation of detail specifications*

The detail specification shall contain all the necessary information to identify the particular type, style(s) and variant(s) of sensitive switches which it covers.

This information shall include at least the following, if applicable:

- a) ratings and characteristics;
- b) outline and detailed dimensions;
- c) number of poles;
- d) mounting details;
- e) functional operation;
- f) sealed or non-sealed;
- g) form of actuator;
- h) actuator positions and mechanical operating characteristics;
- i) terminations;
- j) contact arrangement;
- k) assessment level.

#### 1.5.2 *Outline and detailed dimensions*

There shall be an illustration or a drawing of the sensitive switch as an aid to easy recognition and for comparison with other types of sensitive switches. Drawings shall be either first angle or third angle projection. The projection method shall be stated by the detail specification. Illustrations shall be an isometric view.



The dimensional limits necessary for mounting and interchangeability shall be prescribed in the drawing with variable dimensions given in tables. All dimensions shall be stated in millimetres. Where the original dimensions are in inches, the inch dimensions shall be given in brackets.

### 1.5.3 Safety requirements

If necessary, safety requirements shall be specified in the detail specification by reference to the relevant safety specification.

## 2 Preferred ratings and characteristics

### 2.1 Rated voltages

The preferred voltage ratings for switches with rated voltages above 50 V are 63, 100, 125 and 250 V.

### 2.2 Rated currents

The following current ratings are preferred for d.c. or r.m.s. values:

- less than 1,0 A: no preferred increments of current ratings;
- 1,0 A to 2,0 A: current ratings shall be in 0,25 A increments;
- 2,0 A to 10 A: current ratings should be in 0,5 A increments;
- more than 10 A: current ratings should be in 1,0 A increments.

### 2.3 Climatic categories

The sensitive switches covered by this part of IEC 1020 may be classified into climatic categories according to the general rules of IEC 68-1 and the following:

#### 2.3.1 Lower category temperature

The following temperatures are preferred:

-10 °C	-40 °C
-25 °C	-55 °C

#### 2.3.2 Upper category temperature

The following temperatures are preferred:

55 °C	85 °C	125 °C
70 °C	100 °C	

#### 2.3.3 Damp heat, steady state

The preferred numbers of days for the damp heat, steady state test are 4, 10, 21 and 56 days.

## 2.4 *Environmental test severities*

### 2.4.1 *Shock, test Ea, IEC 68-2-27*

300 m/s <sup>2</sup> (30 g)	18 ms
500 m/s <sup>2</sup> (50 g)	11 ms
1 000 m/s <sup>2</sup> (100 g)	6 ms

The number of shocks in each plane shall be prescribed in the detail specification.

### 2.4.2 *Vibration, test Fc, IEC 68-2-6*

10 - 55 Hz,	displacement	0,75 mm
10 - 150 Hz,	displacement	0,75 mm
10 - 500 Hz,	acceleration	98 m/s <sup>2</sup> (10 g)
10 - 2 000 Hz,	acceleration	98 m/s <sup>2</sup> (10 g)

Duration shall be prescribed in the detail specification.

### 2.4.3 *Low air pressure, test M, IEC 68-2-13*

25,0 kPa (250 mbar)
8,0 kPa (80 mbar)
2,0 kPa (20 mbar)
1,0 kPa (10 mbar)

## 2.5 *Endurance test severities*

10 000 cycles	200 000 cycles
20 000 cycles	500 000 cycles
50 000 cycles	1 000 000 cycles
100 000 cycles	

## 3 *Quality assessment procedures*

### 3.1 *Qualification approval procedures*

Qualification approval procedures shall be as prescribed by 3.4 of IEC 1020-1 and the following.

- a) The tests required for qualification approval are prescribed in table 1 and shall be used for approval of a single style of switch.

For approval of multiple styles of the same switch type, the total quantity of test specimens for each test and the proportion of each representative style shall be proposed by the manufacturer and shall be accepted by the National Supervising Inspectorate. Spare test specimens are permitted. The principles of structural similarity may be applied.

After completion of group 0 tests, the sample shall be divided for the other groups. The tests within a group shall be performed in the order shown except that group 0 tests may be performed in any sequence.

Specimens found defective during the tests of group 0 shall not be used for other groups.

"One defective" is counted when a switch has not satisfied all or part of the requirements of a group.

Qualification approval is granted when the number of defective units does not exceed the specified number of permissible defectives for each group and the total number of permissible defectives for each group.

The conditions of test and the performance requirements for qualification approval tests shall be the same as for quality conformance inspection.

b) Test specimens shall be as specified in the detail specification and shall be representative of the range of products described in it.

Table 1 - Test schedule for qualification approval

Subclause number and test designation (see note 1)	M, MA or WS	Conditions of test (see note 1)	Sample size and criterion of acceptability (see note 2)				Performance requirements (see note 1)
			n	td	c	t	
<b>Group 0 (non-destructive)</b>							
4.3.1 Visual examination	M			0	0	0	$R \leq \dots \text{ m}\Omega$ $R \geq \dots \text{ M}\Omega$ Leakage current: $\leq \dots \mu\text{A}$ Within limits
4.3.5 Functional operation	M						
4.4.2 Contact resistance (see note 3)	WS	$\dots \text{ V}, \dots \text{ A}$					
4.4.4 Insulation resistance	WS	$\dots \text{ V}$					
4.5.1 Voltage proof	M	$\dots \text{ V}$					
4.3.6 Operating characteristics	M						
<b>Group 0A (non-destructive)</b>							
4.3.2 Dimensions	M		4	NA	0		Within limits Within limits Make: $\leq \dots \text{ ms}$ Break: $\leq \dots \text{ ms}$ $C \leq \dots \text{ pF}$
4.3.4 Mass	WS						
4.3.7 Contact bounce	WS	Mounting: Connections:					
4.1.8.1 Capacitance	WS						
<b>Group 1 (destructive)</b>							
4.8.4 Robustness of terminations	MA	$U_a, U_b, U_c$ or $U_d$	4		1	1	No damage
4.8.1 Robustness of actuator (see 4.3 herein)	M	$\dots \text{ N}$			1		No damage
4.11.1 Electrical overload	WS				1		No damage
4.10 Electrical endurance (see note 3)	M	$\dots \text{ cycles}$ $\dots \text{ V}, \dots \text{ A},$ $\dots \text{ load}$			1		Sticks/misses $\leq \dots \text{ per} \dots \text{ cycle}$
4.6.1 Temperature rise	WS				1		$\leq 45 \text{ }^\circ\text{C}$
4.4.2 Contact resistance (see note 3)	WS	$\dots \text{ V}, \dots \text{ A}$			1		$R \leq \dots \text{ m}\Omega$
4.4.4 Insulation resistance	WS	$\dots \text{ V}$			1		$R \geq \dots \text{ M}\Omega$
4.5.1 Voltage proof	M	$\dots \text{ V}$			1		Leakage current: $\leq \dots \mu\text{A}$
4.3.6 Operating characteristics	WS				1		Within limits
4.14 Panel seal (see note 3)	MA				0		No water ingress
4.15 Enclosure seal (see note 3)	MA				0		Leak rate $\leq \dots$
<b>Group 2 (destructive)</b>							
4.12.3 Rapid change of temperature	WS	$\dots \text{ }^\circ\text{C UCT}$ $\dots \text{ }^\circ\text{C LCT}$	4	NA	1	2	Monitor: $\leq \dots \text{ s}$
4.7.2 Vibration (see 4.2 herein)	WS	$\dots \text{ frequency}$ $\dots \text{ acceleration}$					
4.7.1 Shock (see 4.1 herein)	WS	$\dots \text{ acceleration}$ $\dots \text{ pulse width}$					Monitor: $\leq \dots \text{ s}$
4.12.1 Climatic sequence (see 4.4 herein)	WS	UTC $\dots \text{ }^\circ\text{C}$ LTC $\dots \text{ }^\circ\text{C}$ $\dots \text{ kPa}$ remaining damp heat cycles					No damage
4.4.2 Contact resistance (see note 3)	WS	$\dots \text{ V}, \dots \text{ A}$					$R \leq \dots \text{ m}\Omega$
4.4.4 Insulation resistance	WS	$\dots \text{ V}$					$R \geq \dots \text{ M}\Omega$
4.5.1 Voltage proof	M	$\dots \text{ V}$					Leakage current: $\leq \dots \mu\text{A}$
4.3.6 Operating characteristics	M						Within limits
4.3.5 Functional operation	M						

Table 1 (continued)

Subclause number and test designation (see note 1)	M, MA or WS	Conditions of test (see note 1)	Sample size and criterion of acceptability (see note 2)				Performance requirements (see note 1)
			n	td	c	t	
<b>Group 3 (destructive)</b> 4.12.2 Damp heat 4.4.2 Contact resistance (see note 3) 4.4.4 Insulation resistance 4.5.1 Voltage proof 4.3.6 Operating characteristics 4.3.5 Functional operation	WS WS WS M M M	... days ... V, ... A ... V ... V	4	NA	1	↑	No damage $R \leq \dots \text{m}\Omega$ $R \geq \dots \text{M}\Omega$ Leakage current: $\leq \dots \mu\text{A}$ Within limits
<b>Group 4 (destructive)</b> 4.8.2 Robustness of mounting bushing 4.8.3 Robustness of mounting screws 4.16.1 Immersion in cleaning solvents 4.4.2 Contact resistance (see note 3) 4.4.4 Insulation resistance 4.5.1 Voltage proof 4.3.6 Operating characteristics	MA MA WS M WS M WS	... Nm torque ... Nm torque Type of solvent ... V, ... A ... V ... V	4	NA	1	↑	No damage No damage $R \leq \dots \text{m}\Omega$ $R \geq \dots \text{M}\Omega$ Leakage current: $\leq \dots \mu\text{A}$ Within limits
<b>Group 5 (destructive)</b> 4.18.1 Capacitance 4.9 Mechanical endurance 4.4.2 Contact resistance (see note 3) 4.18.1 Capacitance 4.4.4 Insulation resistance 4.5.1 Voltage proof 4.3.6 Operating characteristics 4.14 Panel seal (see note 3) 4.15 Enclosure seal (see note 3)	WS WS M WS WS WS WS MA MA	... cycles ... V, ... A ... V ... V	4	NA	1	↑	$C \leq \dots \text{pF}$ $R \leq \dots \text{m}\Omega$ $C \leq \dots \text{pF}$ $R \geq \dots \text{M}\Omega$ Leakage current: $\leq \dots \mu\text{A}$ Within limits No water ingress
<b>Group 6 (destructive)</b> 4.12.7 Contact resistance stability	WS	... cycles ... operations / min ... °C for ... h	4	NA	1	↑	$R \leq \dots \text{m}\Omega$
<b>Group 7 (destructive)</b> 4.13.1 Solderability (see notes 3 and 4.6 herein)	MA		2	NA	0	0	
<b>Group 8 (destructive)</b> 4.13.4 Resistance to soldering heat 4.3.6 Operating characteristics	MA WS	Method: ... ; with screen (WS)	4	NA	1	1	Within limits

Table 1 (continued)

Subclause number and test designation (see note 1)	M, MA or WS	Conditions of test (see note 1)	Sample size and criterion of acceptability (see note 2)				Performance requirements (see note 1)
			n	td	c	t	
<b>Group 9 (destructive)</b> 4.18.1 Capacitance 4.10.2 Electrical endurance (UCT) 4.4.2 Contact resistance (see note 3) 4.18.1 Capacitance 4.4.4 Insulation resistance 4.5.1 Voltage proof 4.3.6 Operating characteristics	WS WS M WS WS WS WS	... cycles ... V, ... A, load ... V, ... A ... V ... V	4	NA	1	↑	NA ≤ ... pF Sticks/misses: ... per cycle R ≤ ... mΩ C ≤ ... pF R ≥ ... MΩ Leakage current: ≤ ... μA Within limits
<b>Group 10 (destructive)</b> 4.5 Corrosion, salt mist (herein)	WS		4	NA	1	↑	

**NOTES**

1 The subclause numbers of the test and performance requirements refer to Part 1 of IEC 1020, the supplementary requirements being specified in this part of IEC 1020.

2 All specimens in the sample shall be submitted to the tests of group 0. The specimens for group 0 shall then be subdivided for the other groups. In the groups, all specimens shall be subjected to the required tests and all tests shall be performed in the sequence shown. Spare test specimens may be included in group 0.

3 The appropriate test method shall be specified by the detail specification.

4 In this table:

- M = test is mandatory
- MA = test is mandatory if applicable to the switch construction
- WS = test is mandatory when specified by the detail specification
- n = sample size
- td = test acceptance criterion (permitted number of defectives per test)
- c = group acceptance criterion (permitted number of defectives per group)
- t = total acceptance criterion (permitted number of defectives for one or several groups combined, for example group 0, group 1, group 2 to 6 inclusive)
- NA = not applicable
- UCT = upper category temperature
- LCT = lower category temperature

5 When the detail specification includes additional tests, additional test groups may have to be added. In this case, the sample size for group 0 shall be increased by the respective number of specimens.

6 Final measurements including, for instance, contact resistance and voltage proof tests used as final measurements in groups 2 to 10, shall not be made if the preceding tests in the group to which they belong are not specified.

### **3.2 Quality conformance inspection**

Quality conformance inspection shall be as prescribed by 3.5 of IEC 1020-1 and the following requirements.

- a) The lot-by-lot inspection tests are prescribed in the blank detail specification. The sequence of tests is optional unless otherwise specified. Inspection level II or S2 shall apply.
- b) The periodic inspection tests are prescribed in the blank detail specification.

An inspection lot may consist of structurally similar switches provided the conditions of 3.3 of IEC 1020-1 are met.

For periodic inspections, the proportion of test specimens of different styles shall be the same as for qualification approval tests.

All test specimens which are subjected to the periodic inspection shall have passed Group A tests.

The conditions of test and the performance requirements for the quality conformance inspection shall be the same as for the qualification approval.

The prescribed AQL's apply to each attribute inspected during the test.

At the manufacturer's option, a more stringent AQL may be used.

### **3.3 Delayed deliveries**

Switches held for more than three years following the release of the inspection lot shall be re-examined in accordance with the specified lot-by-lot inspection tests prior to delivery. The procedure for the re-examination shall be approved by the National Supervising Inspectorate. Once a lot has been re-examined, its quality is reassured for three more years.

Switches with solderable terminals which are held more than one year following the release of the inspection lot shall be re-examined for solderability prior to delivery. The procedure for the re-examination shall be approved by the National Supervising Inspectorate. Once a lot has been re-examined for solderability, its quality is assured for one more year.

## **4 Test methods and requirements**

This clause supplements the test methods and requirements of IEC 1020-1.

The specified operating characteristics shall be measured by any appropriate means commensurate with the parameter being measured and its tolerance, if any.

### **4.1 Shock**

The switch shall be monitored in accordance with the contact disturbance test (4.7.3 of IEC 1020-1) for contact opening or closure. The duration of any contact disturbance shall be 10  $\mu$ s, 100  $\mu$ s, 1 ms or 10 ms as specified by the detail specification.

#### 4.2 Vibrations

The method of the vibration test of 4.7.2 of IEC 1020-1 shall be supplemented as follows.

The switch shall be monitored in accordance with the contact disturbance test (4.7.3 of IEC 1020-1) for contact opening or closure. The duration of any contact disturbance shall be 10  $\mu$ s, 100  $\mu$ s, 1 ms or 10 ms as specified by the detail specification.

#### 4.3 Robustness of actuator

The force to be applied on the plunger actuator is  $F7 \geq 45$  N (10 pounds) for sensitive switches.

#### 4.4 Climatic sequence

The method of the climatic sequence test (4.12.1 of IEC 1020-1) shall be supplemented as follows:

The number of cycles to be performed during the cyclic damp heat test shall be determined by the duration specified for the damp heat, steady state test of 4.12.2 of IEC 1020-1 as follows:

<i>Damp heat, steady state</i>	<i>Damp heat, cyclic</i>
4 days	1 cycle with assisted recovery
10 days	1 cycle
21 days	2 cycles
56 days	6 cycles

#### 4.5 Corrosion, salt mist

**Method:** The test shall be performed in accordance with IEC 512-6, test 11f. The following details shall apply:

- a) the switch shall be suspended from the top of the chamber by a material which is known to be nonreactive to the salt mist;
- b) the duration of the test shall be 96 h unless otherwise specified;
- c) after the test group sequence, the switches shall be subjected to the functional operation test (4.3.5 of IEC 1020-1).

**Requirement:** After the test, there shall be no damage which impairs the mechanical and/or electrical operation of the switch.

#### 4.6 Solderability

The solderability tests of 4.13.1, 4.13.2 and 4.13.3 of IEC 1020-1 may be performed on terminals prior to their assembly into the switch if the final terminal finish has been applied.